

CLAIMS

What is claimed is:

1. A biological analysis system comprising:
 - an excitation module, comprising:
 - a collimator element configured to receive excitation light from at least one excitation light source and to transmit collimated excitation light along an excitation light path in a first direction; and
 - a plurality of excitation mirrors arrayed along the excitation light path, wherein each excitation mirror is disposed at an acute angle relative to the first direction and configured to reflect a respective beam of collimated excitation light along a second direction of the excitation light path; and
 - an emission module positioned to receive excitation light transmitted along the second direction of the excitation light path, the emission module comprising:
 - a sample block comprising a plurality of sample receptacles, each sample receptacle positioned to receive a respective beam of collimated excitation light transmitted along the second direction of the excitation light path; and
 - a plurality of photodetectors, each photodetector configured to receive emission light transmitted in a third direction from a respective sample receptacle, the third direction being transverse to the second direction of the excitation light path.
2. The biological analysis system of claim 1, wherein the excitation module additionally comprises a plurality of excitation lenses arrayed such that each excitation lens is positioned in the second direction of the excitation light path and is configured to focus a respective, reflected beam of collimated light into a respective focused beam of excitation light to be received at a respective sample receptacle of the emission module.
3. The biological analysis system of claim 1 or claim 2, wherein each photodetector is oriented in the third direction toward the respective sample receptacle.
4. The biological analysis system of any one of claims 1–3, wherein the third direction is substantially orthogonal to the second direction of the excitation light path.

5. The biological analysis system of any one of claims 1–4, wherein the emission module additionally comprises a plurality of emission lenses configured to focus emission light transmitted in the third direction onto the plurality of photodetectors.
6. The biological analysis system of claim 5, wherein the emission module additionally comprises a plurality of emission filters corresponding to the plurality of emission lenses, the plurality of emission filters being positioned downstream of the corresponding plurality of emission lenses and configured to allow emission light to pass through the emission filter and to substantially block stray excitation light.
7. The biological analysis system of claim 6, wherein the plurality of emission filters comprise dual bandpass filters.
8. The biological analysis system of any one of claims 5–7, wherein each emission lens comprises a curved lens.
9. The biological analysis system of any one of claims 1–8, wherein the emission module further comprises a plurality of emission windows, each emission window associated with a respective sample receptacle and defining an area through which emission light is transmitted to downstream components in the third direction.
10. The biological analysis system of any one of claims 1–9, wherein at least one of the plurality of excitation mirrors is independently adjustable.
11. The biological analysis system of any one of claims 1–10, wherein the plurality of excitation mirrors are arrayed in a staggered, diagonal pattern formed by a first center point of a first excitation lens being offset vertically and horizontally from a second center point of a second excitation lens, and the acute angle of each excitation mirror in the staggered, diagonal pattern is between 50° and 75° relative to the first direction.
12. A biological analysis system comprising:
an excitation module comprising:

an excitation light source configured to emit excitation light in a first direction;

an excitation mirror selectively movable between a plurality of predefined positions, each predefined position forming an acute angles relative to the first direction and being configured to reflect the excitation light along a second direction; and

a plurality of excitation lenses arrayed such that each excitation lens is positioned in the second direction and is configured to receive a reflected beam of excitation light directed thereto by the excitation mirror positioned in a respective predefined position; and

an emission module comprising:

a plurality of sample receptacles positioned to receive focused beams of reflected excitation light from the corresponding plurality of excitation lenses; and

at least one photodetector configured to receive emission light transmitted in a third direction from the plurality of sample receptacles, the third direction being transverse to the second direction.

13. The biological analysis system of claim 12, wherein the emission module additionally comprises a plurality of emission lenses and a plurality of emission filters configured to focus and filter the emission light onto the at least one photodetector.

14. The biological analysis system of claim 13, wherein the at least one photodetector comprises a plurality of photodetectors, each photodetector configured to receive emission light from a respective sample receptacle, the emission light having been focused and filtered by respective emission lenses and respective emission filters before being received at each photodetector.

15. The biological analysis system of any one of claims 12–14, further comprising a sample loading system configured to removably secure one or more sample containers within corresponding sample receptacles of the plurality of sample receptacles.

16. The biological analysis system of claim 15, wherein the sample loading system further comprises a closing mechanism configured to exert a closing force on—and to positionally secure—the one or more sample containers within the corresponding sample receptacles.
17. The biological analysis system of any one of claims 12–16, wherein the emission light comprises fluorescence radiation from one or more excited fluorescent labels.
18. The biological analysis system of any one of claims 12–17, further comprising a plurality of emission apertures, wherein each emission aperture is associated with a respective emission lens of the plurality of emission lenses, and wherein each emission aperture is aligned in the third direction and defines an area through which emission light is received from the sample receptacle by the respective emission lens.
19. The biological analysis system of claim 18, wherein a center point of the emission aperture is aligned with an optical center of the respective emission lens.
20. A biological analysis system, comprising:
- at least two excitation light sources emitting different excitation wavelengths;
 - a collimator element configured to receive excitation light from the at least two excitation light sources and to transmit collimated excitation light along an excitation light path in a first direction;
 - a plurality of excitation mirrors disposed at an acute angle relative to the first direction and configured to reflect the collimated excitation light into a plurality of reflected beams of excitation light along a second direction of the excitation light path;
 - a plurality of excitation lenses positioned in the second direction of the excitation light path and configured to focus respective, reflected beam of collimated light into corresponding focused beams of excitation light;
 - a sample block forming a plurality of sample receptacles, wherein the plurality of sample receptacles are positioned to receive the corresponding focused beams of excitation light; and

for each respective sample receptacle, the biological analysis system comprises at least the following components aligned in a third direction, the third direction being transverse to the second direction:

an emission window defining an area through which emission light is transmitted in the third direction;

an emission lens configured to focus the emission light passing through the emission window;

an emission filter configured to allow the emission light to pass through the emission filter and to substantially block stray excitation light; and

a photodetector configured to receive the focused, filtered emission light.

21. The biological analysis system of claim 20, wherein the sample block comprises a plurality of receptacles configured to receive a plurality of sample containers, each sample container is configured to receive a sample.

22. The biological analysis system of claim 20 or claim 21, wherein each receptacle of the plurality of receptacles comprises a receptacle opening configured to receive a gasket, and wherein the receptacle opening is configured to allow engagement between the gasket and a top portion of one sample container of the plurality of sample containers.

23. The biological analysis system of claim 21 or claim 22, further comprising a closing mechanism configured to exert a closing force on the plurality of sample containers.

24. The biological analysis system of claim 23, wherein the closing mechanism comprises a plurality of biasing members.

25. The biological analysis system of 24, wherein each biasing member of the plurality of biasing members is independently operable.

26. The biological analysis system of any one of claims 20–25, wherein the plurality of receptacles is disposed in a single row.

27. The biological analysis system of any one of claims 20–26, wherein each emission filter comprises two dual bandpass filters, and wherein each dual bandpass filter is configured to block a range of wavelengths corresponding to the excitation light.
28. The biological analysis system of any one of claims 20–27, wherein the emission lens comprises a curved lens.
29. The biological analysis system of any one of claims 20–28, wherein each of the plurality of excitation lenses comprises a focal length, and wherein each focal length is independently selectable.
30. The biological analysis system of any one of claims 20–29, wherein at least one of the plurality of excitation mirrors is independently adjustable.